

## **605 STEEL GUIDERAILS**

### **605.01 W BEAM/THRIE BEAM GUIDERAIL**

**(A) DESCRIPTION.** Work shall consist of the fabrication and erection of steel Thrie beam and W beam type guiderail of single or double face type of the dimensions and placement shown in the contract documents or as directed by the Engineer.

Work shall include all forming, galvanizing, replacement of damaged pieces, labor, tools, and equipment necessary to complete the items of work, accepted in place.

**(B) MATERIALS.** Materials shall meet the following requirements:

W/Thrie Beam Rail Elements, Back-up  
Pieces, and Terminal Sections - AASHTO M 180, Class A, Type I  
Rail Posts, Offsets, Angles, Channels and Shims - 815.01(A)  
Tie Rods - 815.01(A)  
Splice Bolts, Nuts, and Washers - 815.01(L)  
Anchor Bolts and Nuts - 815.01(D)  
Anchor Rods and Nuts - 815.01(A)  
Anchorage Casting Plates - 815.01(I)  
Reflectors - 821.15(C)  
Turnbuckles - 815.14  
PCC - 817, Class F  
Epoxy - 821.10  
Galvanizing - 811.07  
Reinforcing Steel - 812.02

**(C) FABRICATION.** The mill and fabrication shop shall follow the practices and meet the requirements of the current edition of the Code Of Standard Practice For Steel Buildings And Bridges Of The AISC.

Requirements of AASHTO M 160 shall be met at all times.

All parts shall be fabricated; all bolt holes shall be drilled or subpunched and reamed in the shop. No field drilling or punching of holes, field cutting, burning, or welding will be allowed without the approval of the Engineer.

Terminal sections shall be the rounded type as shown on the plans.

Post bolts and splice bolts shall be machined button head shoulder bolts with roll threaded Class 2 A fit before galvanizing; shoulder or neck shall have an oval shape as shown on the plans.

Hex nuts for rail connections shall be machined American Standard Heavy type with a recess to accommodate shoulder on bolts.

Bolts and nuts for offsets and anchors shall be machined American Standard Heavy type.

Posts and offsets shall be of the size, and cut to the proper lengths, as shown in the contract documents. Offsets shall be bolted to posts after galvanizing. End posts and first intermediate posts for each installation shall have anchors bolted to the posts in the manner shown in the contract documents.

For all installations, bolts and nuts shall be galvanized, conforming to AASHTO M 232.

Rail elements, backup pieces, and terminal sections shall be hot-dip galvanized, conforming to 811.07.

Posts, offsets, and anchors shall be hot-dip galvanized conforming to 811.07.

**(D) WELDING.** All welding shall be done in conformance with 706.18.

**(E) CONSTRUCTION REQUIREMENTS.**

**(1) GENERAL.** Prior to erection, all parts shall be inspected for damage and for chipped or marred coatings. Pieces warped, deformed or with damage to galvanizing will be rejected and the Contractor will be required to replace any such damaged parts at his expense. Paint touch-up of marred or chipped galvanizing will not be permitted.

All posts shall be plumb and erected to lines and grades shown in the contract documents. The flange front edges of all posts shall be within 1/4 inch of their correct position.

Rail lengths for W Beam rail shall be 12 feet 6 inches long with 25 foot lengths optional.

Rail elements shall be erected to produce a smooth rail paralleling the line and grade of the highway or as shown on the plans. Rails shall be installed with the double corrugation faces toward traffic and the edges turned away from traffic. Edges and center corrugation of the rail shall contact each offset. Backup pieces shall be installed between rail and post at each intermediate post where shown on the plans. Reflectors shall be installed under the post rail bolt at the alternate posts.

All splices shall be lapped in the direction of traffic. Each end of every installation shall be fitted with a rounded type terminal section and lapped on the face of the rail.

Ends of each installation which are not approach ends shall be fitted with a standard terminal piece.

Connecting bolts shall not be finally tightened until rails have been properly aligned, adjusted, and approved by the Engineer.

After final tightening of nuts, projecting threads on all bolts shall be burred to prevent removal.

**(2) INSTALLATION.** The following construction methods shall be used for the various type installations:

**(a) Installations in Earth.** Posts shall be spaced as shown on the plans, measured along the center corrugation of the rail. Post hole excavation shall be roughly circular with a diameter of approximately 8 inches. After placing a post and bracing in a plumb position, the hole shall be backfilled with approved embankment material and thoroughly compacted by tamping to obtain as rigid an installation as possible.

In lieu of excavating and setting posts in prepared holes, posts may be driven if approved by the Engineer. When posts are driven, post tops shall be protected against damage by use of a driving cap and the surrounding earth compacted after driving. When driving, blows shall be applied axially to the post and not to the offset. Any post damaged from driving shall be withdrawn, not used, and another post placed.

Posts may also be driven in existing sidewalk areas where there will be no interference with utilities, catch basins, sewers, etc. In these areas, the existing concrete shall be removed by cutting a square 8 inches by 8 inches to a depth of 1-1/2 inches below the sidewalk with a power masonry saw. The remainder of the

concrete may be removed by other methods. After the posts are driven, the concrete shall be replaced. Payment for concrete will be made under "PCC for Post Anchorage".

**(b) Installation in Existing Concrete** - Where the existing concrete is of sufficient depth to accommodate the anchor bolts, installation shall be made in predrilled anchor holes.

**Predrilled Anchor Holes** - Holes shall be drilled to diameters as specified in 605.01(E)(2)(c). Drilling templates shall be used for all drilling operations to insure properly aligned true anchorage holes. Where dry drilling is employed, the holes shall be vacuumed or blown out using oil-free compressed air. Where drilling process requires the use of water, holes shall be carefully washed out after drilling to remove any drilling slurry residue which may remain. Holes shall then be permitted to dry thoroughly before placing bolts.

The Contractor is warned that he may encounter reinforcing or utilities upon drilling anchor holes in concrete. Diamond drilling or other special procedures necessary to construct anchorage shall be included as part of the work. All cost involved in connection with drilled anchorages shall be included as part of work. The Contractor shall assume the entire responsibility for all damage and injury to electrical conduits, utilities, and the structure. Repair of any damage shall be included as part of the work.

Where existing concrete is of insufficient depth to accommodate the anchor bolts, the existing concrete shall be removed to a rectangle approximately 4 inches greater in each dimension than the base plate to be used. The concrete shall be cut to a neat line to a depth of 1-1/2 inches below the concrete surface with a masonry power saw. The rest of the concrete and soils may be removed by other methods.

#### **(c) Anchor Bolt Installation**

**(1) Epoxy Installation** - Bolts and bolt holes shall be clean, degreased with toulene, and dry at the time of installation. Bolts may be installed by either of the following methods:

- Holes shall be drilled in existing concrete to diameters not to exceed one quarter (1/4) inch greater than the diameter of the bolts or dowels being embedded, or as recommended by the epoxy manufacturer. The bolts and dowels shall be fixed with an epoxy resin adhesive meeting the requirements of 821.10(B)(2).

- Holes shall be drilled in existing concrete to diameters at least one (1) inch greater than the diameter of the bolt or dowel being embedded. The bolts and dowels shall be fixed with an epoxy mortar meeting the requirements of 821.10(C).

Using either of the methods specified above, the locations of the holes to be drilled shall be accurately determined by means of templates. The templates shall also be used to hold the bolts in position until the epoxy resin or mortar has cured. The temperature of the concrete where bolts are being installed shall be at least 40°F at the time of installation.

**(2) Anchor Dowel Installation** - Where bolted anchorages are to be set on PCC mortar blocks, anchor dowels shall be carefully preset by template prior to placing the PCC sidewalk, median, or anchor block.

**(3) Base plates** shall be set level by the use of steel shims or an epoxy mortar bed to insure plumb posts.

When steel shims are used, they shall be so designed to provide full bearing between full area of base plate and shims and that no gaps appear between base plates and concrete.

If an epoxy mortar bed is used, it shall be applied to provide a level bed of mortar 1 inch greater in each horizontal direction than base plate. It shall be a minimum of 1/4 inch thick on the high side and the complete area of the base plate shall be in contact with the mortar bed.

**(F) MEASURE.** The unit of measure for W Beam and/or Thrie Beam Rail will be the linear foot. The number of linear feet will be the actual length of steel beam guide rail measured, complete in place, along face of corrugation center to center of end posts for each installation. Length of terminal sections will not be included. In the case of double- faced guiderail, measurement will be made along the centerline of posts, center to center of end posts.

Where types of installation change, measurement for each type will begin and/or end mid-way between the posts but will not include Special Units.

The unit of measure for PCC for Post Anchorage will be the cubic yard, based on field measurement.

Guiderail Reflectors will not be measured for payment.

**(G) PAYMENT.** The number of linear feet of W Beam and Thrie Beam Rail, as measured herein will be paid for at the contract unit price per linear foot, including equipment and incidentals (excluding guiderail reflectors) necessary to complete the work.

Payment for PCC for Post Anchorage will be made at the contract unit price per cubic yard. Payment will include furnishing and curing PCC, backfilling and all other incidentals.

No payment will be made for Guiderail Reflectors. The cost of furnishing and installing this item will be included in the contract unit price for the appropriate W-Beam Rail pay item.

Payment for anchor bolts or bolt holes will be included in the contract unit price for the appropriate W Beam Rail pay item.

Payment for excavation will be made under the appropriate excavation items.

## **605.02 W BEAM SPECIAL UNITS**

**(A) DESCRIPTION.** Work consists of the construction of the units outlined hereunder. Materials, fabrication, and construction shall meet the requirements of 605.01(B), (C), (D) and (E) and also as specified herein.

- (1) GUIDERAIL TIE ANCHOR** - The unit shall consist of:
- 6 feet 3 inch section of rail
  - Standard Terminal piece
  - 1-1/2 inch diameter galvanized rod, turnbuckle and anchor plate
  - Miscellaneous hardware
  - PCC anchor and anchor post

Deadman Anchor Blocks shall not be constructed until anchor posts are in the proper place. Stay-in-place forms may be used, or concrete may be placed against plumb, undisturbed earth if approved by the Engineer.

Tie rods shall be positioned prior to concrete placement so that the tie rod is oriented correctly and loosely connected to the anchor at the post. After the deadman has cured, the tie rod and turnbuckle shall be securely tightened.

The area around the block shall be backfilled and graded with embankment material meeting requirements of 204.

**(2) GUIDERAIL APPROACH TERMINAL.** Abutments, Piers, Walls, and Parapets. Unit consists of:

- PCC anchor block
- 25 feet of single section of rail
- Posts on 3 feet 1-1/2 inch spacing, complete with offset posts
- Anchor bolts and other incidental hardware

**(3) GUIDERAIL EXIT TERMINAL.** Abutments, Piers, Walls, and Parapets. Unit consists of:

- PCC anchor block
- 25 feet of single section of rail
- Posts on 6 feet 3 inches spacing, complete with offset posts.
- Anchor bolts and other incidental hardware

**(4) MODIFIED ECCENTRIC LOADER TERMINAL.** The Modified Eccentric Loader Terminal (MELT) consists of all items comprising the full 37'-6" length of the unit. It includes, but is not limited to the following items:

1. Two regular line posts, complete with offsets.
2. Four short wood breakaway line posts, complete with offsets.
3. Two long wood breakaway line posts, complete with offsets.
4. Three ARTBA RE-3[12'-6" W-beam sections] with varying hole spacings.
5. One Anchor Plate Assembly.
6. One Buffered End Assembly.
7. One Cable Assembly.
8. One Strut and Yoke Assembly
9. Two steel tubes.
10. Other incidental hardware and fasteners.

The MELT shall be laid out according to the "Post Layout" sheet found in the contract drawings. Tolerances for flare offsets shall be limited to 5% for the front three (3) posts and 10% for the rear four (4) posts.

**(5) W-BEAM/THRIE BEAM TRANSITION PANEL.** The unit shall consist of one (1) section, as detailed in the contract documents, for connecting W-beam guiderail to thrie beam guiderail or thrie beam impact attenuators, or thrie beam guiderail to fixed objects. Also included is the incidental hardware required for installation.

**(B) MEASURE AND PAYMENT.** The unit of measure for all Special Units will be each. The number will be the actual number of each type of Special Unit installed complete and accepted. Payment will be at the contract unit price per each for the respective unit. Payment will include furnishing all components as specified for the particular Special Units, to include: all steel components including galvanizing, PCC units, treated timber posts, cable assemblies, and anchors. Payment will also include work performed for erection of Special Units complete, including excavation, backfilling, disposal of unsuitable materials, shop drawings, and all labor, material, tools, equipment, and incidentals necessary to complete the work.

### **605.03 RUB RAIL**

**(A) DESCRIPTION.** Work consists of adding a channel section, to be used as a rub rail, on existing or new guiderail installations at the locations as shown on the plans, or as directed.

**(B) CONSTRUCTION REQUIREMENTS.** 605.01(C) and 605.01(E) apply with the following additions:

1. New posts shall be pre-drilled at the fabricator.
2. Existing posts shall be field drilled.
3. Edges of field-drilled holes shall be given one coat of zinc primer.
4. Expansion splices shall be located as shown on the plans, or as directed.
5. Channels shall be of such a length as to accommodate the post spacing with a 50 foot maximum length.
6. The Contractor shall make a field inspection of existing guiderail installations so that required channel lengths can be accurately determined.
7. On curves greater than 3 degrees, 15 minutes, the channel shall be fabricated to fit the required curvature.

**(C) MEASURE AND PAYMENT.** The unit of measure for Rub Rail will be the linear foot, with measurements made along the top of the channel section. Payment shall be the contract unit price per linear foot, which payment will include furnishing, fabricating, galvanizing, field drilling, touch- up painting, installation, tools, labor, equipment and incidentals necessary to complete the work.

### **605.04 PCC TERMINAL BLOCK**

**(A) DESCRIPTION.** Work consists of the construction of PCC Terminal Blocks of various dimensions and at locations as shown in the contract documents, or as directed. Work shall include excavation, forming, reinforcing steel, PCC, labor, tools, and equipment necessary to complete the item.

**(B) CONSTRUCTION REQUIREMENTS.** The Contractor shall perform the necessary excavation to construct the PCC Terminal Block. Whenever possible, the excavation shall be done in undisturbed earth. Unsuitable excavated materials shall be disposed of by the Contractor. PCC work shall be done in conformance with applicable provisions of 501. After the PCC has cured, the area around the PCC Terminal shall be backfilled with Embankment Fill meeting the requirements of 204. Anchor bolts may be inserted in the plastic concrete or in expansion shields that may be installed in pre-drilled holes. The anchors shall be included as part of Guiderail Items.

**(C) MEASURE AND PAYMENT.** The unit of measure for PCC Terminal Block will be the cubic yard, with measurement based on the plan dimensions.

Payment will be made at the contract price per cubic yard, which payment will include excavation, backfill, disposal of excess and unsuitable excavated materials, forming, PCC, reinforcing steel, tools, labor, equipment, and incidentals necessary to complete the work.

### **605.05 BOX BEAM GUIDERAIL**

**(A) DESCRIPTION.** Work consists of furnishing all labor, materials, equipment, and incidentals necessary to fabricate, galvanize, transport, and erect box beam guiderails and box beam special units as shown in the contract documents or as directed.

**(B) MATERIALS.** The following requirements apply:

Box Beam Railing - ASTM A 500, Grade B, or ASTM A 501  
Plates, Posts, Angles and Shims - 815.01(A)  
Splice Bolts - 815.01(L)  
Anchor Bolts and Nuts - 815.01(D)  
Epoxy - 821.10  
Sand - 803.01  
PCC - 817, Class F  
Galvanizing - 811.07  
Neoprene Pad - 821.02(C)

The Contractor shall submit to the Engineer certified mill test reports and written certification that the material meets the specified requirements for all steel tubing and structural shapes.

**(C) FABRICATION.** Applicable provisions of 706.12 shall apply with the following additions:

Shop drawings shall be submitted for approval in accordance with the requirements of 105.02.

The mill and fabrication shop shall follow the practices of and meet the requirements of the current edition of the Code Of Standard Practice For Steel Buildings And Bridges Of The AISC.

Requirements of AASHTO M 160 shall be met at all times.

All parts shall be shop fabricated. All bolt holes shall be drilled or sub-punched and reamed in the shop.

Except where an existing installation is being upgraded, no field drilling or punching of holes, field cutting, burning, or welding will be allowed unless approved by the Engineer.

Box beam rails shall be a minimum of 24 feet and a maximum of 42 feet in length.

**(D) WELDING.** The requirements of 706.18 apply.

**(E) TRANSPORTATION AND FIELD STORAGE.** Loading, transportation, unloading, and field storage of guiderail elements shall be conducted so as to avoid injury and deformation of the guiderail elements. Damaged pieces shall be repaired or replaced at the Contractor's expense.

Special care shall be exercised and protective shimming, wrapping, or other means employed to protect galvanized surfaces from mechanical damage due to handling, storing, or erecting procedures.

## **(F) CONSTRUCTION REQUIREMENTS.**

**(1) GENERAL.** Prior to erection, all parts shall be inspected for damage and for chipped or marred coatings. Pieces warped, deformed, or with substantial galvanized areas damaged to bare steel, as determined by the Engineer, will be rejected and the Contractor shall replace such damaged parts with parts meeting these specifications at his sole expense. Marred or chipped areas in the galvanizing such as scratches extending nearly to bare steel, raw edges, spotting, etc., considered to be minor from an aesthetic or corrosion standpoint, as determined by the Engineer, shall be properly cleaned and carefully touched up with a zinc rich paint containing not less than 93 percent zinc by weight. The color of the touchup paint shall be a silver-gray which will blend with galvanized surfaces. Yellow-green shades of zinc paint will not be permitted. Surface scratches will not require touchup.

All posts shall be spaced as shown on the plans and erected to the lines and grades as shown on the plans, or as directed. The flange front edges of all posts shall be within 1.4 inch of their correct position.

**(2) POST INSTALLATIONS.** Section 605.01(E) and the following apply.

**Installation on Structures.** Where installation is to be made on an existing structure and the depth of the deck is less than the required depth for anchor bolts, the installation shall be made as follows:

**(a)** Holes shall be drilled through the concrete deck. The Contractor shall prevent broken concrete, other materials, and tools from falling onto any traveled roadway, sidewalk, or other public space where the safety of the public may be endangered.

**(b)** The base plates on Neoprene pads if required, shall then be anchored to the deck with bolts, anchor plates, or any other method as shown on the plans or as directed.

**(3) RAIL INSTALLATION.** Rails shall be erected to produce a smooth, continuous rail, parallel to the existing grade. Expansion sleeves shall be installed at all expansion joints and dams on structures. On PCC median installations off the structure, where transverse expansion joints cross the median, expansion sleeves shall be installed at every third joint or at a maximum of 90 feet. All splices and expansion couplings shall be of the internal type. Connecting bolts shall not be finally tightened until the rails have been properly aligned, adjusted, and approved by the Engineer.

**(G) MEASURE AND PAYMENT.** The unit of measure for Box Beam Guiderail will be the linear foot.

Measure will be made along the top of rail center-to-center of the last posts of each type of installations or to the beginning or ending of special units.

Payment for Box Beam Guiderail will be made at the contract unit price per linear foot.

## **605.06 REMOVE GUIDERAIL BURIED TERMINAL**

**(A) DESCRIPTION.** All existing buried terminal sections shall be removed and replaced with modified eccentric loader terminal (MELT) sections or various impact attenuator devices. Work consists of the complete removal of buried terminal sections including single and double rail, the PCC anchor block, anchorage shoe or shoes, 25 feet of twisted guiderail(s) plus the runout rail(s), and intervening posts, brackets, and hardware. Work also includes necessary excavation and backfilling holes from which anchor block and posts are removed and disposal of all unusable guiderail elements including anchor block. Usable elements, if any, shall be saved for reuse.

**(B) MEASURE AND PAYMENT.** The unit of measure for Remove Guiderail Buried Terminal will be each. The number will be the actual number of buried terminals, single or double rail, completely removed. Payment for Remove Guiderail Buried Terminal will be made at the contract unit price per each, which payment will include complete removal of the buried terminal sections, including excavation and backfilling, disposal of all unsuitable elements, and all labor, materials tools, equipment and incidentals necessary to complete the work.

## **605.07 REMOVE W-BEAM/THRIE BEAM GUIDERAIL**

**(A) DESCRIPTION.** Work consists of removing, dismantling, cleaning, touch-up painting, and storing of existing W beam and/or Thrie beam guiderail.

All rail elements shall be carefully removed from the posts, and all guiderail elements shall be carefully examined. Those elements meeting the Engineer's approval shall be stockpiled in an area acceptable to the Engineer. All rails and posts shall be cleaned and any marred or chipped areas in the



galvanizing shall be painted with a zinc-rich paint. Elements determined by the Engineer to be unsuitable shall be disposed of properly.

All post holes shall be backfilled with applicable material and compacted. Anchor bolts in existing PCC shall be removed by burning off flush with the PCC and the area painted with a zinc-rich paint.

**(C) MEASURE AND PAYMENT.** The unit of measure for Remove W Beam/Thrie Beam Guiderail will be the linear foot of guiderail removed with measurement made along the front face of the guiderail or along the posts for double-faced guiderail. Payment will be made at the contract unit price per linear foot, which payment will include removal, dismantling, cleaning, touch-up painting, stockpiling, disposal of unusable elements, backfill and compaction of post holes, and all labor, tools, equipment, and incidentals necessary to complete the work.

## **605.08 RESET W-BEAM/THRIE BEAM GUIDERAIL**

**(A) DESCRIPTION.** Work consists of resetting usable guiderail, removed and stored as per 605.07.

Sections 605.01(B) through 605.01(E) apply.

**(B) CONSTRUCTION REQUIREMENTS.** Section 605.01(E) applies with the following additions:

Any materials damaged or missing prior to, during or subsequent to removal due to the Contractor's negligence, shall be replaced at his expense. Additional posts, offsets, back-up pieces, plate washers, bolts, nuts, reflectors, and other necessary equipment needed to provide 6 feet 3 inches post spacing will be included as part of this item.

Additional rail-post bolt holes shall be drilled after the rail is reset. Edges of field-drilled holes shall be given 1 coat of zinc-rich paint.

**(C) MEASURE AND PAYMENT.** The unit of measure for Reset W Beam/Thrie Beam Guiderail will be the linear foot of guiderail reset, with measurement made along the front face of the guiderail. Payment will be made at the contract unit price per linear foot, which payment will include furnishing all additional required materials, shop drawings, galvanizing, field drilling, touch-up painting, and all labor, tools, equipment and incidentals necessary to complete the work.

## **605.09 EXTRA GUIDERAIL COMPONENTS**

**(A) DESCRIPTION.** Work consists of furnishing and installing guiderail components which are in addition to the standard guiderail configuration. Transitions to rigid barriers as well as backup plates, posts, rails, offsets and other materials used to "stiffen" sections as directed by the contract plans will be paid for under this item.

**(B) MATERIALS.** Requirements of 605.01(B) and 605.05(B) apply.

**(C) METHODS OF CONSTRUCTION.** Requirements of 605.01(E) and 605.05(F) apply.

**(D) MEASURE.** The unit of measure for EXTRA GUIDERAIL COMPONENTS will be the pound. The weight shall be for the finished galvanized components with galvanizing and allowable overrun percentage in accordance with AASHTO M 111 and AASHTO M 160 respectively. No deduction will be made for bolt holes. No measure will be made for weight of weld metal nor for spike bolts and nuts.

Weights of the hardware components will be computed from the weight determined by the Engineer

or from weights furnished by the manufacturer and approved by the Engineer.

**(E) PAYMENT.** Payment for EXTRA GUIDERAIL COMPONENTS will be made at the contract unit price per pound, which payment will include furnishing and installing galvanized and reflectorized hardware, galvanizing, furnishing, storage, transportation, erection, drilling of bolt holes and all labor, materials, tools, equipment and incidentals needed to complete the work specified.